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Petrology of exhumed mantle rocks at passive margins: ancient lithosphere and rejuvenation processes

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Mantle peridotites from ocean-continent transition zones (OCT's) and ultraslow spreading ridges question the commonly held assumption of a simple link between mantle melting and MORB. 'Ancient' and partly refertilized mantle in rifts and ridges illustrates the distribution of the scale of chemical and isotopic upper mantle heterogeneity even on a local scale. Field data and petrology demonstrates that ancient, thermally undisturbed, pyroxenite-veined subcontinental mantle blobs formed parts of the ocean floor next to thinned continental crust. These heterogeneities might comprise an (ancient?) subduction component. Upwelling of partial melts that enter the conductive lithospheric mantle inevitably leads to freezing of the melt and refertilization of the lithosphere and this process might well be at the origin of the difference between magma-poor and volcanic margins. Similar heterogeneity might be created in the oceanic lithosphere, in particular at slow to ultra-slow spreading ridges where the thermal boundary layer (TBM) is thick and may be veined with metasomatic assemblages that might be recycled in subduction zones. In this presentation, we provide a summary of mantle compositions from the European realm to show that inherited mantle signatures from previous orogenies play a key role on the evolution of rift systems and on the chemical diversity of peridotites exposed along passive margins and ultra-slow spreading ridges. Particularly striking is the abundance of plagioclase peridotites in the Alpine ophiolites that are interpreted as recorders of refertilization processes related to thinning and exhumation of mantle lithosphere. Another important result over the last 20 years was the discovery of extremely refractory Nd-isotopic compositions with highly radiogenic 147Sm/144Nd which indicates that partial melting processes and Jurassic magmatism in the Western Thetys are decoupled. Although the isotopic variability might be explained by mantle heterogeneities, an alternative is that these depleted domains represent snapshots of melting processes that are related to Permian and/or even older crust forming processes. The findings of the these refractory mantle rocks over the entire Western Alpine arc and the similarity in model ages of depletion suggests a connection to the Early Permian magmatic activity. Shallow and deep crustal magmatism in the Permian is widespread over Western Europe and the distribution of these mafic rocks are likely to pre-determine the future areas of crustal thinning and exhumation during formation of the Thethyan passive margins.